CLAIMS

1. A RAKE receiver having a MIXR function, comprising:

a path searcher which detects path timings of a plurality of paths from a received signal;

a MICT generator which generates MICT (Multipath Interference Correlative Timing) for each of the plurality of path timings detected by the path searcher;

a timing selector which selects path timings and MICTs from among the detected path timings and the generated MICTs in such a manner that the total number of timings becomes equal to a predetermined number;

a despreader which despreads the received signal at each of the path timings and the MICTs selected by the timing selector;

a combiner which, if an MICT has been selected for a path timing, combines the result of despreading performed at the timing of the MICT with the result of despreading performed at the path timing; and

a RAKE combiner which combines outputs of the combiner by using a RAKE combining technique.

2. A RAKE receiver according to claim 1, wherein the path timing selector includes:

first processing means for first selecting one path timing from among the plurality of path timings;

second processing means for determining one of unselected MICTs as a candidate for selection for the selected path timing;

third processing means for selecting one timing from among unselected path timings and the MICT determined as the candidate for selection; and

fourth processing means for causing processing in the second and third processing means to be repeated until the number of selected timings reaches the predetermined number.

3. A RAKE receiver according to claim 2, wherein the first processing means selects the path timing where the value of SNIR (Signal to Noise and Interference Ratio) is the largest.

4. A RAKE receiver according to claim 2, wherein the first processing means selects the path timing where the signal power is the largest.

5. A RAKE receiver according to claim 2, wherein the second processing means determines, as the candidate for selection, the MICT that is evaluated as being most effective in improving SNIR when MIXR combining is done.

6. A RAKE receiver according to claim 2, wherein the second processing means determines as the candidate for selection the MICT where the signal power or SNIR of an interference path is the largest.

7. A RAKE receiver according to claim 2, wherein the third processing means selects the path timing or MICT where SNIR expected to be achieved by RAKE combining after MIXR combining performed by adding the selected timing is evaluated as being the largest.

8. A RAKE receiver according to claim 7, wherein the third processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = \frac{\sigma_i^2}{\sigma_i^2 - \frac{|\alpha_i|^2 |\alpha_j|^2 I^2}{RSSI}}$$

where σ_i^2 is signal variance at the path i, $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively, I^2 is a transmitter's transmitting power estimated at receiving end, and RSSI is received signal intensity.

9. A RAKE receiver according to claim 7, wherein

the third processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_i|^2}{|\alpha_j|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

10. A RAKE receiver according to claim 7, wherein the third processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_j|^2}{|\alpha_i|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

11. A RAKE receiver according to claim 1, wherein the timing selector calculates SNIR for each path timing and an increase in SNIR expected to be achieved by MIXR combining for each MICT, and selects the predetermined number of timings in decreasing order of the SNIR and in order of decreasing magnitude of the SNIR increase.

12. A RAKE receiver according to claim 11, wherein the path timing selector calculates the increase in SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the

improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_j|^2}{|\alpha_i|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

13. A RAKE receiver according to claim 1, wherein the timing selector includes:

fifth processing means for selecting all the path timings; and

sixth processing means for selecting MICTs in a prescribed order after selecting all the path timings, until the total number of selected timings reaches the predetermined number.

14. A RAKE receiver according to claim 13, wherein the sixth processing means selects MICTs in decreasing order of SNIR expected to be achieved by RAKE combining after MIXR combining.

15. A RAKE receiver according to claim 13, wherein the sixth processing means selects MICTs in decreasing order of a value obtained by multiplying path signal power with an SNIR improvement achieved by MIXR combining.

16. A RAKE receiver according to claim 13, wherein the sixth processing means selects MICTs in order of decreasing magnitude of the signal power or SNIR of an interference path.

17. A RAKE receiver according to claim 14, wherein the sixth processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = \frac{\sigma_i^2}{\sigma_i^2 - \frac{|\alpha_i|^2 |\alpha_j|^2 I^2}{RSSI}}$$

where σ_i^2 is signal variance at the path i, $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively, I^2 is a transmitter's transmitting power estimated at receiving end, and RSSI is received signal intensity.

18. A RAKE receiver according to claim 14, wherein the sixth processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_i|^2}{|\alpha_j|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

19. A RAKE receiver according to claim 14, wherein the sixth processing means evaluates the SNIR expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_j|^2}{|\alpha_i|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

20. A RAKE receiver according to claim 1, wherein when one of the path timings detected by the path searcher and one of the MICTs generated by the MICT

generator overlap each other on a time axis, the timing selector selects the one which gives the larger SNIR.

21. A RAKE receiver according to claim 1 wherein, when one of the path timings detected by the path searcher and one of the MICTs generated by the MICT generator overlap each other on a time axis, the timing selector selects only the path timing.

22. A RAKE receiver according to claim 1 wherein, when one of the path timings detected by the path searcher and one of the MICTs generated by the MICT generator overlap each other on a time axis, the timing selector uses the result of despreading at the overlapped timing as the result of despreading at the path timing as well as the result of despreading at the MICT.

23. A RAKE receiver according to claim 1, wherein when two of the MICTs generated by the MICT generator overlap each other on a time axis, the timing selector selects only the MICT that gives the larger SNIR.

24. A RAKE receiver according to claim 1 wherein, when two of the MICTs generated by the MICT generator overlap each other on a time axis, the timing selector selects only the MICT where the signal power or the SNIR of an interference path is larger.

25. A RAKE receiver according to claim 1 wherein, when two of the MICTs generated by the MICT generator overlap each other on a time axis, the timing selector uses the result of despreading at the overlapped timing as the result of despreading at the two MICTs.

26. A receiver for receiving a direct code spread signal, comprising: first timing detecting means for detecting path timings of multipaths; second timing detecting means for detecting, based on each of the detected timings, a timing for obtaining an interference reducing signal; timing assigning means for assigning selected ones of the plurality of timings detected by the first and second timing detecting means to a plurality of despreaders, respectively; and a combiner for combining

outputs of the plurality of despreaders.

27. A receiver according to claim 26, wherein the second timing detecting means is a means for detecting a timing located on a time axis at a position symmetric to another timing which is one of the timings detected by the first timing detecting means, the two timings being located symmetrically to each other with respect to a selected one of the timings likewise detected by the first timing means, and

the timing assigning means also assigns the selected one of the timings when assigning the timing detected by the second timing detecting means.

28. A receiver according to claim 26, wherein the timing assigning means includes a changing means for changing any one of the assigned timings to another timing based on signal quality after the RAKE combining so as to improve the quality.

29. A RAKE receiver according to claim 15, wherein the sixth processing means evaluates the signal power expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = \frac{\sigma_i^2}{\sigma_i^2 - \frac{|\alpha_i|^2|\alpha_j|^2 I^2}{RSSI}}$$

where σ_i^2 is signal variance at the path i, $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively, I^2 is a transmitter's transmitting power estimated at receiving end, and RSSI is received signal intensity.

30. A RAKE receiver according to claim 15, wherein the sixth processing means evaluates the signal power expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be

achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_i|^2}{|\alpha_j|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.

31. A RAKE receiver according to claim 15, wherein the sixth processing means evaluates the signal power expected to be achieved by the MIXR combining by evaluating an improvement η_{ij} in SNIR expected to be achieved by the MIXR combining performed using a MICT for a path i with a path j as an interference path, the improvement η_{ij} being calculated by the equation

$$\eta_{ij} = 1 + \frac{|\alpha_j|^2}{|\alpha_i|^2}$$

where $|\alpha_i|^2$ and $|\alpha_j|^2$ are signal powers for the paths i and j, respectively.